Integration and Coordination of Multiple Tributary and Near-Shore Monitoring Efforts and the Use of Technology to Enhance these Efforts

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State of Lake Michigan 2011

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Tributary and Near-Shore Monitoring Efforts

- Lake Michigan Monitoring Coordination Council Near Shore Monitoring work group (LMMCC – NeMo)
- USGS GLRI Rivermouth and Tributary projects
- National Monitoring Network pilot project

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LMMCC NeMo workgroup

- Members: Federal, State, Municipalities, Universities, and Non-profits
- Goals:
  - Understand and inventory nearshore monitoring activities (developing a web mapper);
  - coordinate implementation of a nearshore network;
  - identify monitoring gaps;
  - coordinate database approach;
  - develop a nearshore conceptual model;
  - integrate data reporting.

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Examples of Lake Michigan Nearshore Activities

- USEPA National Coastal Assessment
- University and State near shore Buoys
- University and Federal near shore biology research
- USEPA Triaxus tows of nearshore zone
- USGS GLRI tributary, river mouth, beach, and near shore monitoring (9 projects)
- State and local tributary and river mouth (embayments) monitoring
- UWM sensors on Ferry crossings

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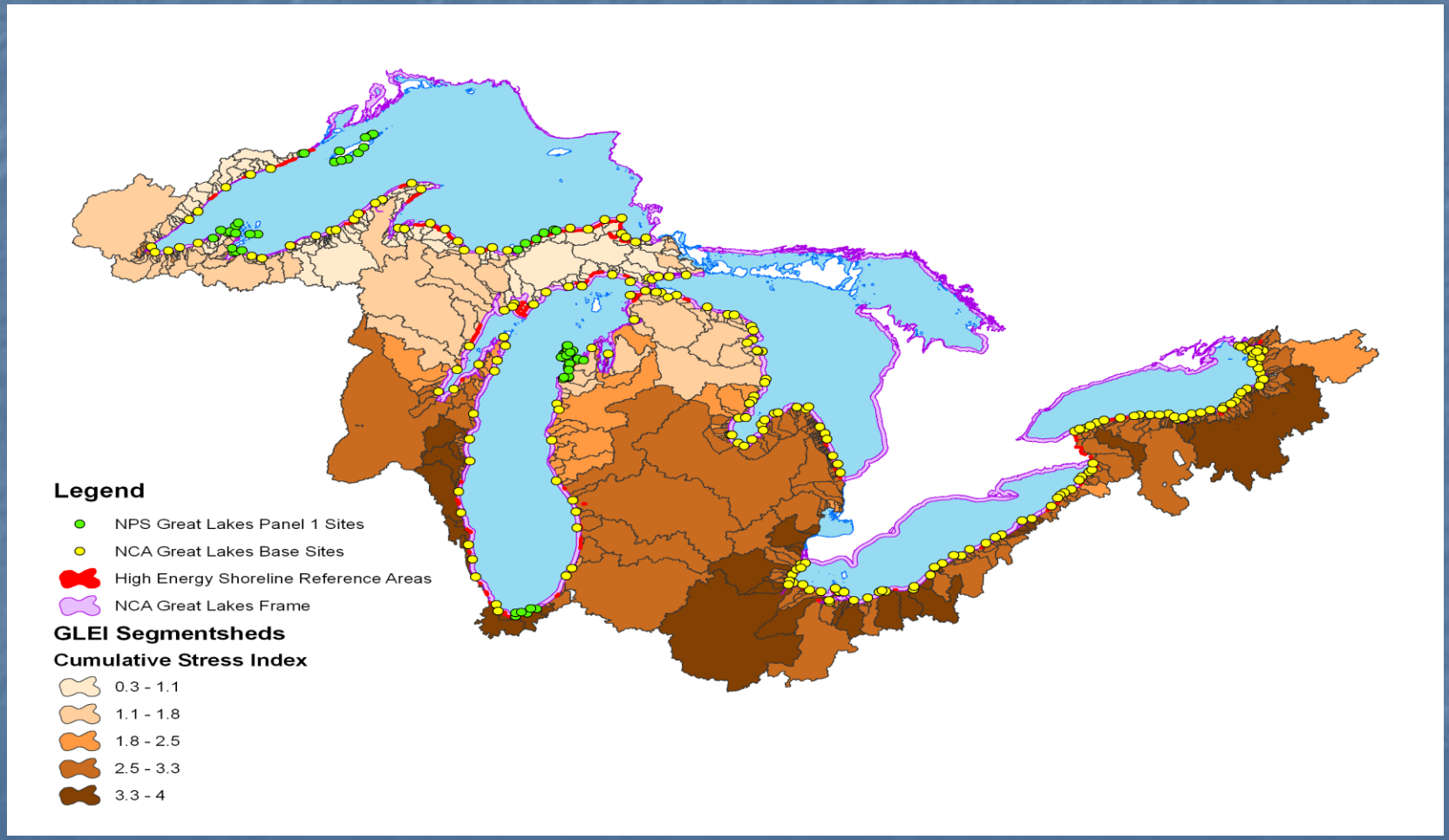
USEPA National Coastal Condition Assessment in the Great Lakes



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Grand Valley State Muskegon River Monitoring

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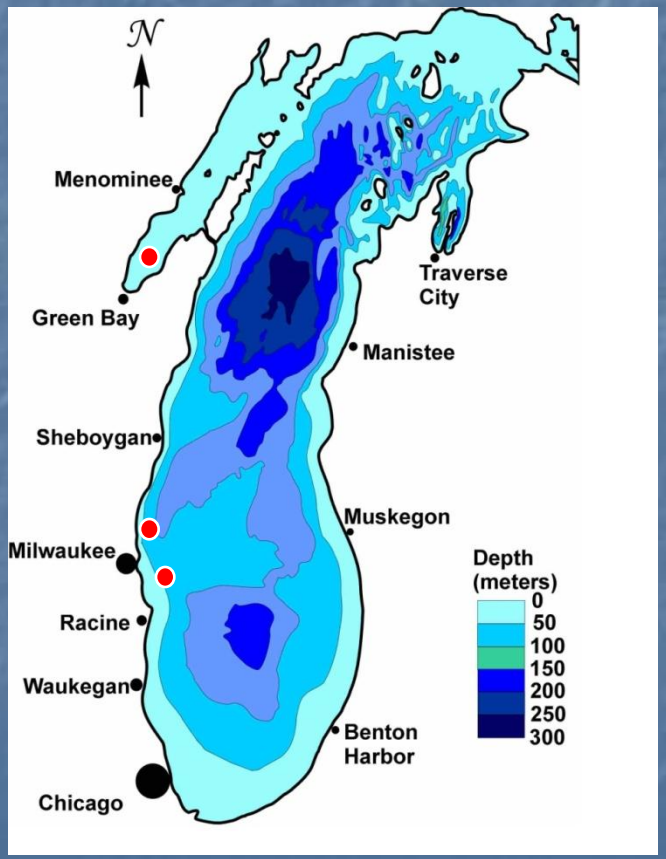
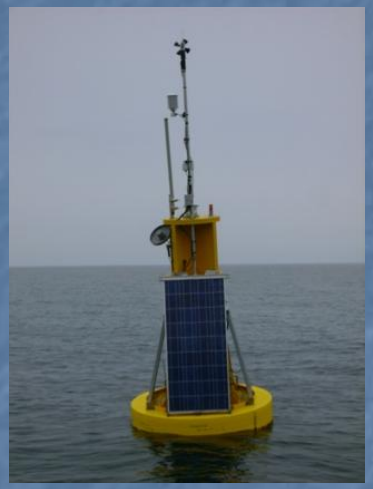
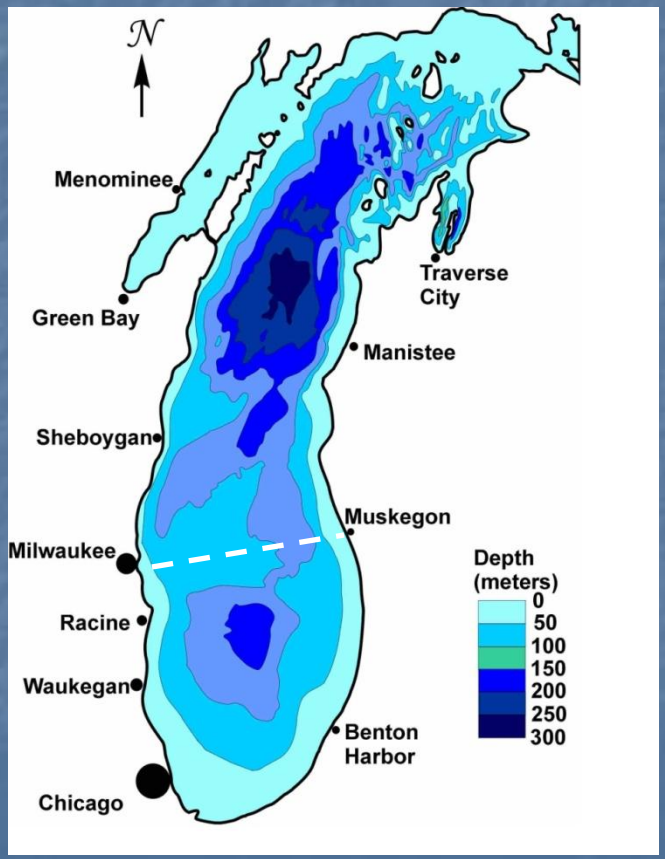
UW-Milwaukee Buoys and Ferry Sensors







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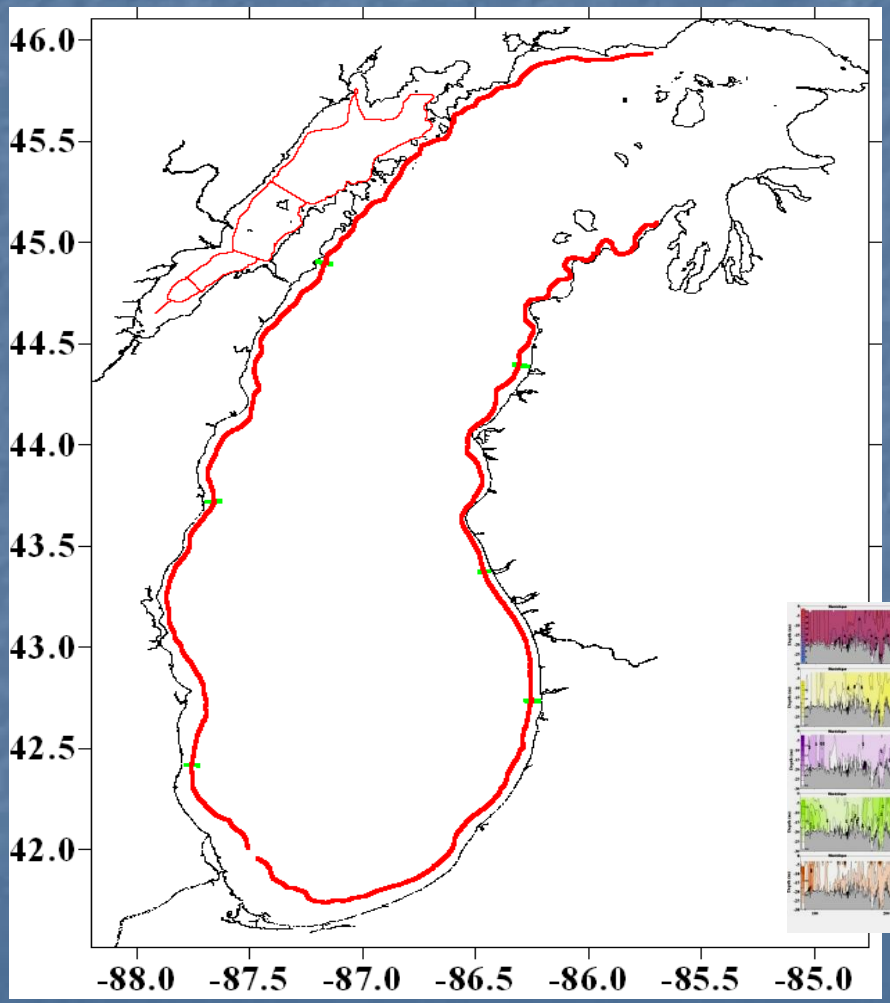
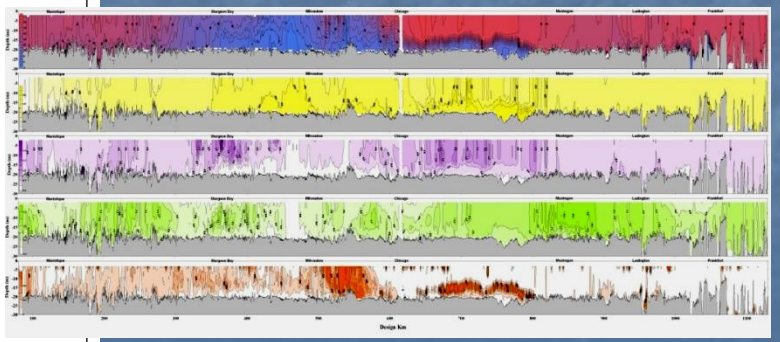
USEPA Lake Michigan 20 m contour Triaxus tow



Sensor suit: CTD (conductivity, temperature, depth), Fluorometer, Transmissometer, Laser Optical Plankton counter , (and limited NO_3 sensor)



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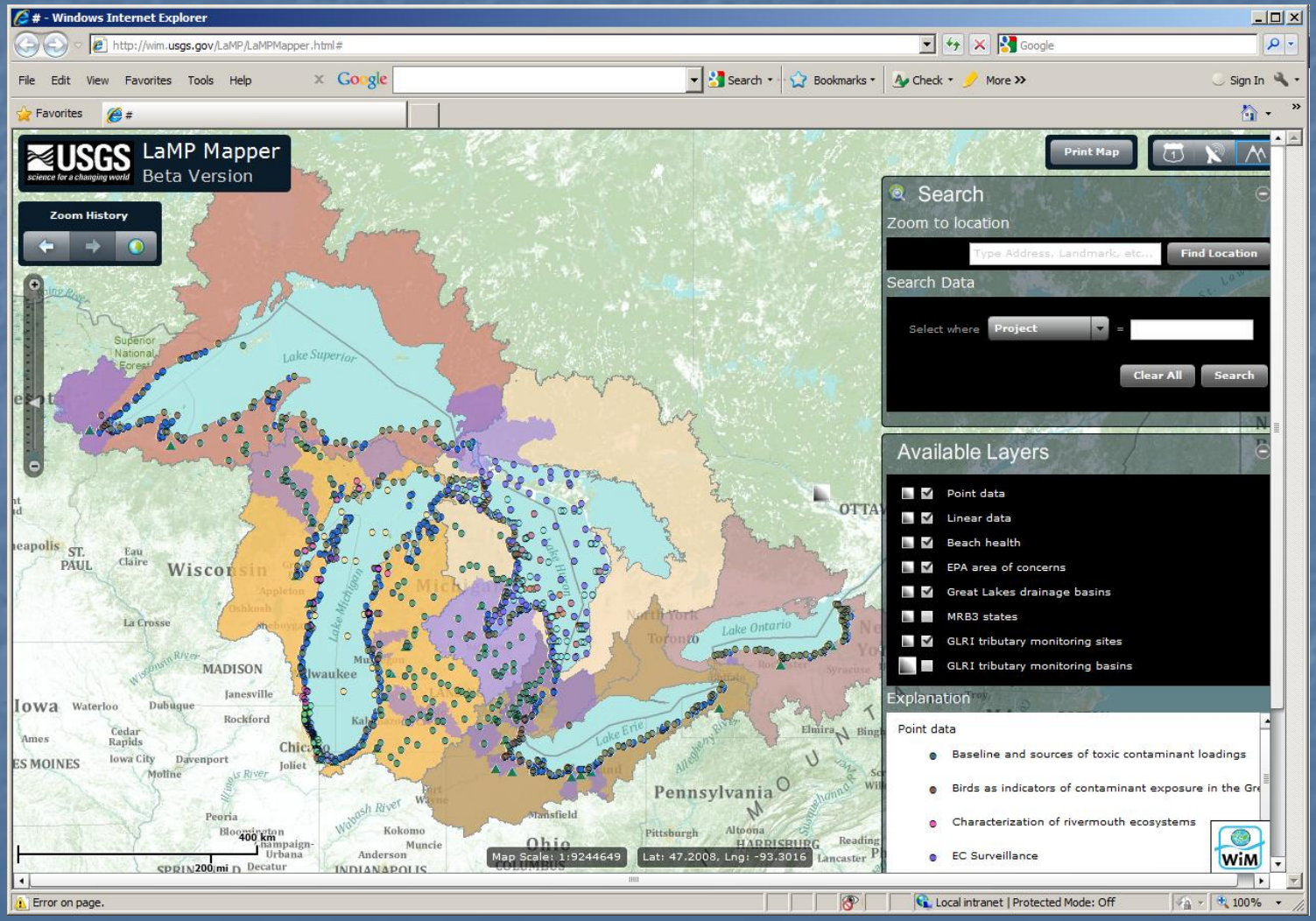
Great Lakes Activities Web Mapping Application



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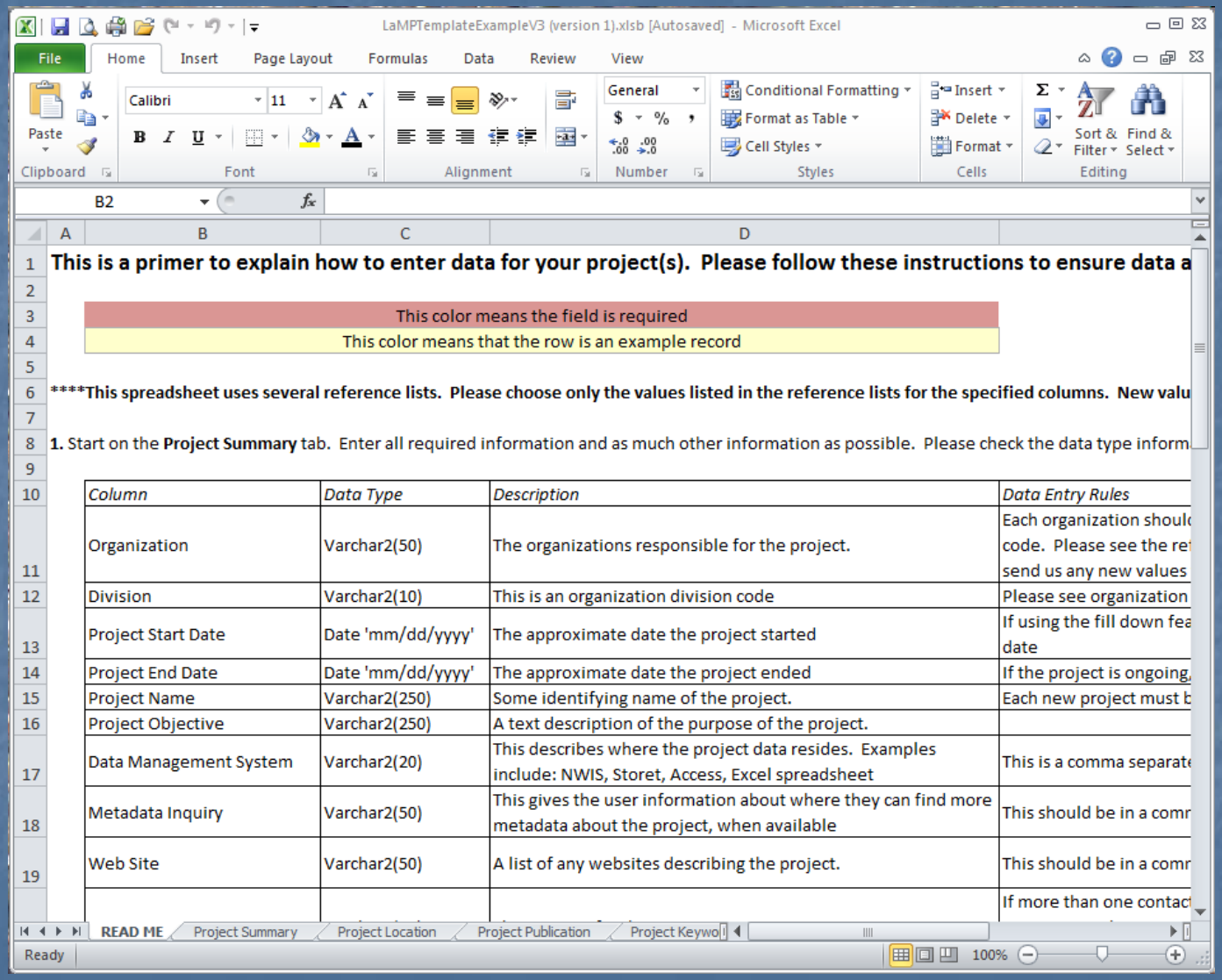
Activities Data Entry System



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USGS GLRI Activities Relative to the National Monitoring Network Design Resource Compartments

- Embayments
- GL Shallow Nearshore
- GL Medium Nearshore
- GL Offshore
- Rivers
- Ground Water
- Atmospheric Deposition
- Beaches
- Wetlands

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Rivermouth Project Objectives

- Conceptual Model
- Classification
- Characterization of Ecosystem Structure and Function
- Collaboratory

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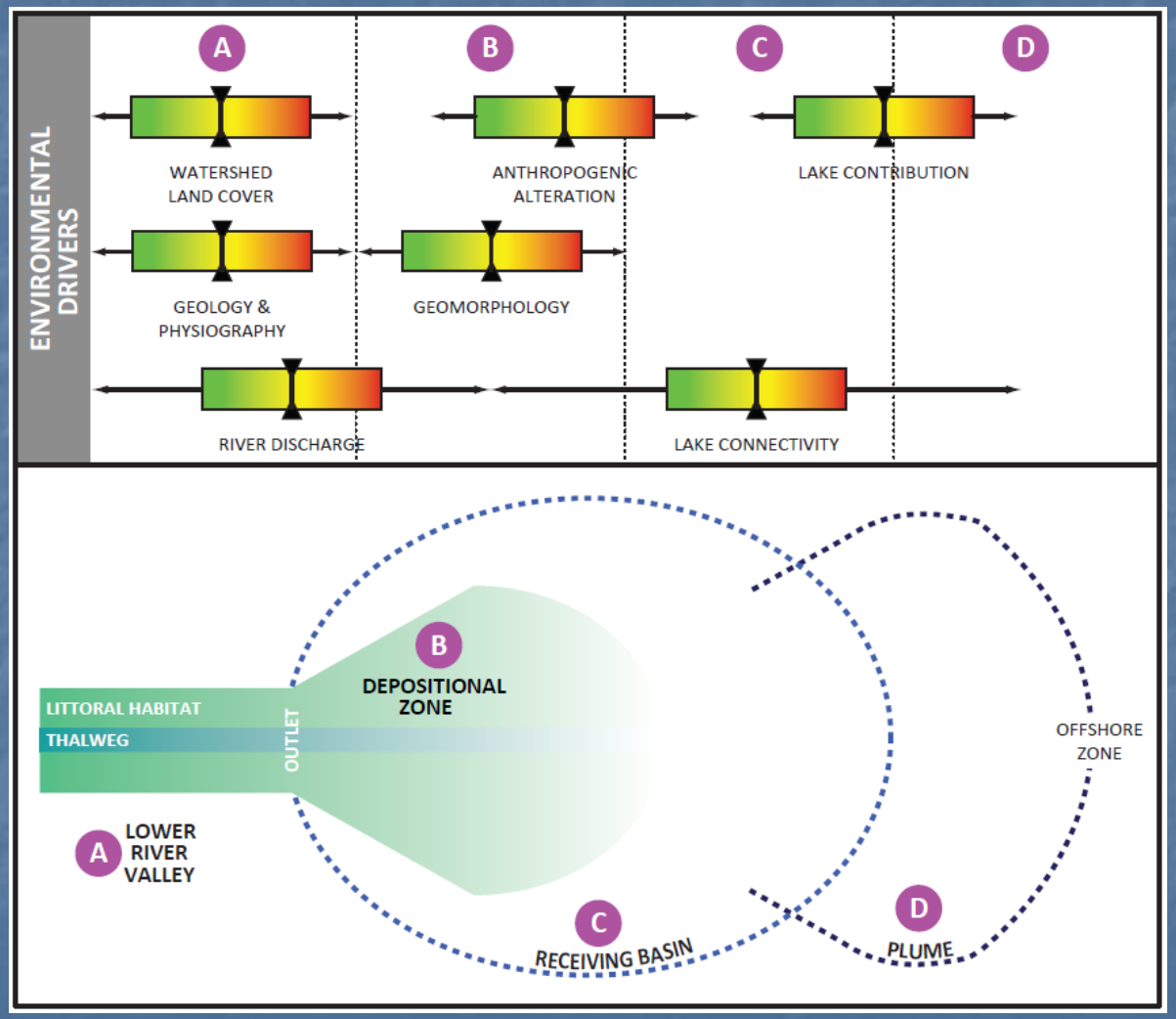
Rivermouth Conceptual Model



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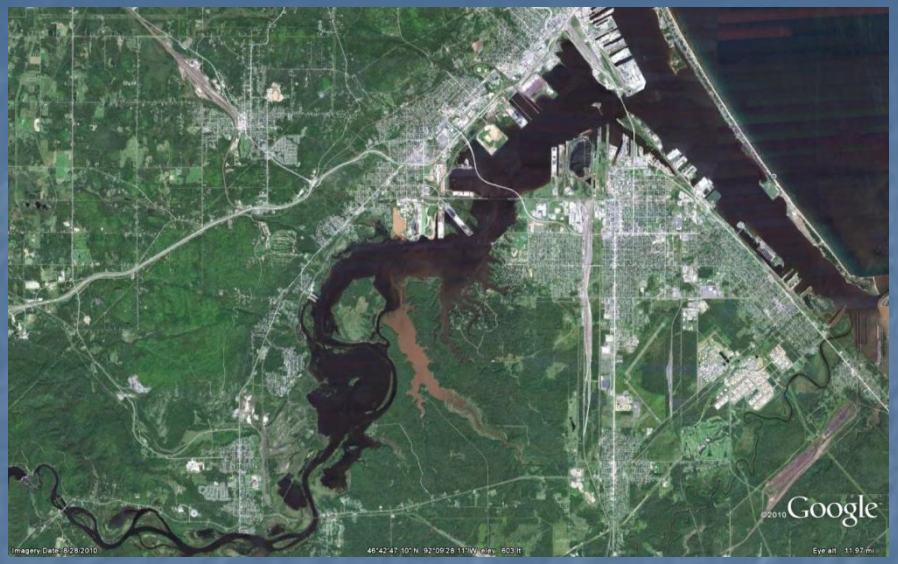
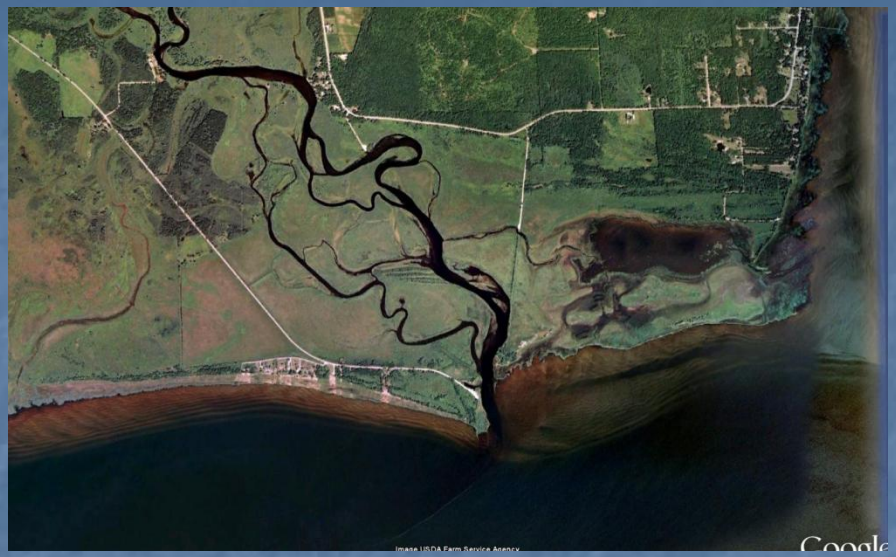
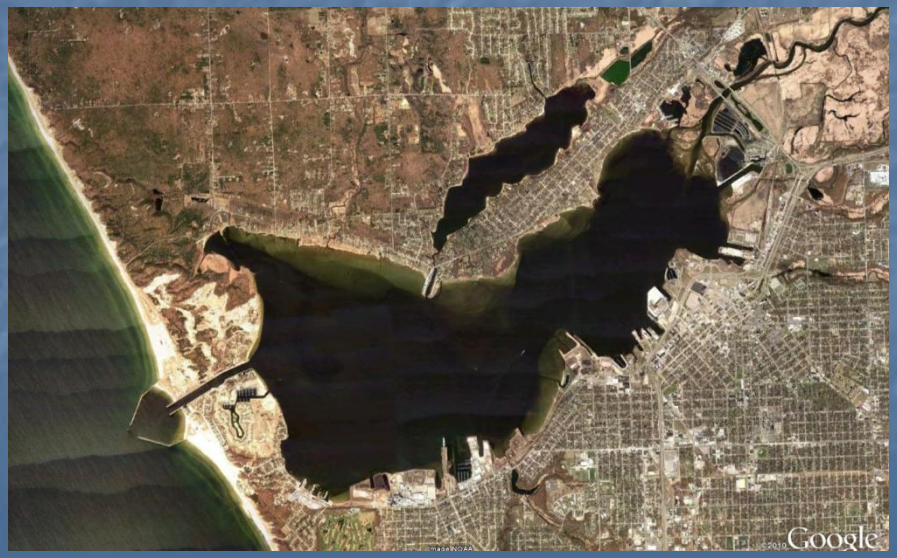
Rivermouth Classification



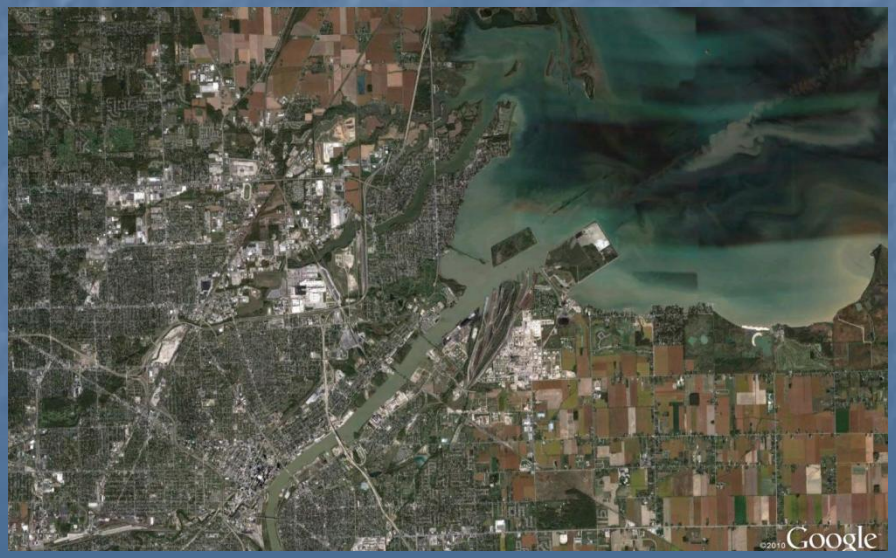
St. Louis River



Peshtigo River



Muskegon River



Maumee River

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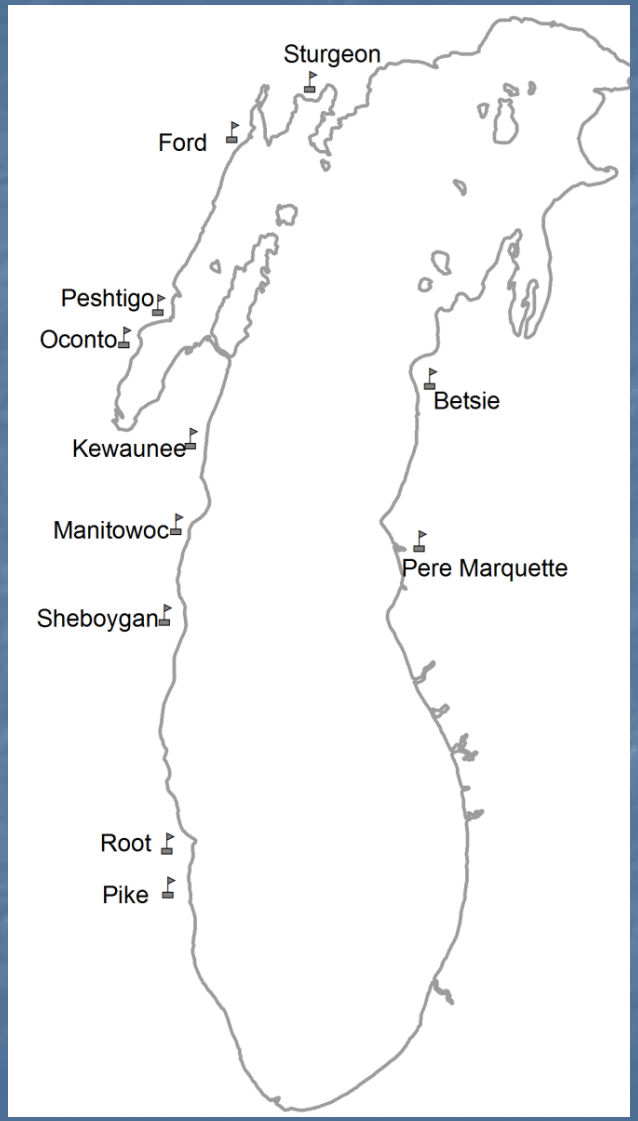
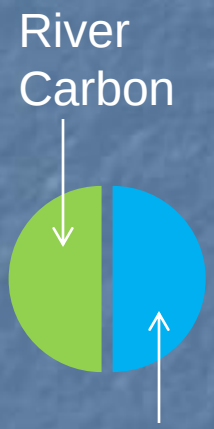
Characterization of Structure and Function





Stream	Consumer
Ford	
Sturgeon	
Peshtigo	
Oconto	
Kewaunee	
Manitowoc	
Sheboygan	
Pere Marquette	
Betsie	na
Root	
Pike	na

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Monitoring Design - Rivers

- 59 NMN river sites - toxic contaminant baseline
- 30 NMN river sites - automated monthly plus high flow sample collection and continuous sensor measurements to forecast/nowcast contaminant loads
- 17 NMN river sites - chemicals of emerging concern baseline
- 15 AOC sites – Toxics in Sediments
- 8 NMN river sites – pathogens and virus baseline

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Tributary Monitoring Project Objectives

- Provide baseline information on contaminant loads at major Great Lakes tributaries,
- Provide quantifiable measures of restoration progress on major Great Lakes tributaries,
- Model potential load changes throughout the Great Lakes,

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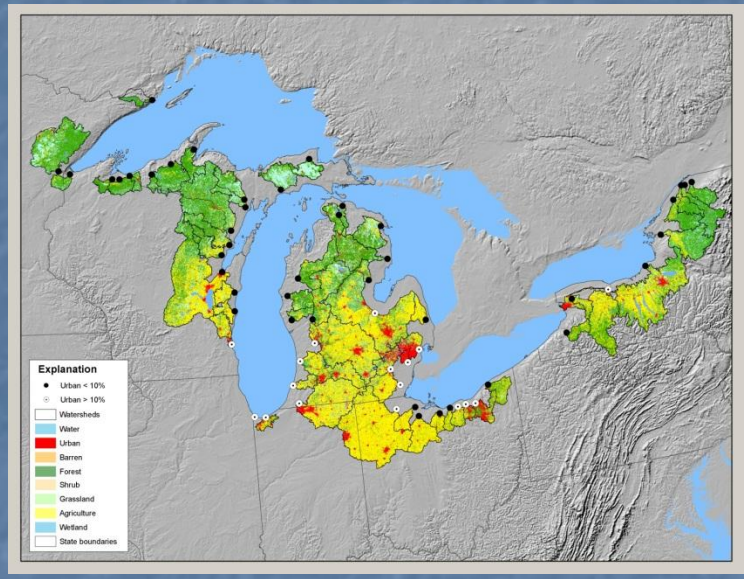
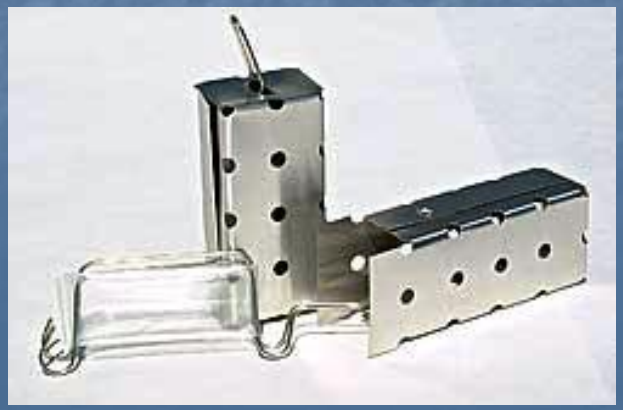
Determine Baseline of Toxic Contaminants

59 NMN sites sampled in fall of 2010



- **POCIS** (Polar Organic Chemical Integrative Sampler) monitor hydrophilic contaminants which could be potentially endocrine disrupting or acutely toxic
- **SPMD** (Semi-permeable membrane devices) designed to mimic biological membranes, such as the gills of fish.
- Water Samples for mercury and organic contaminants collected at time of installation. A 2nd sample collected in 2011.



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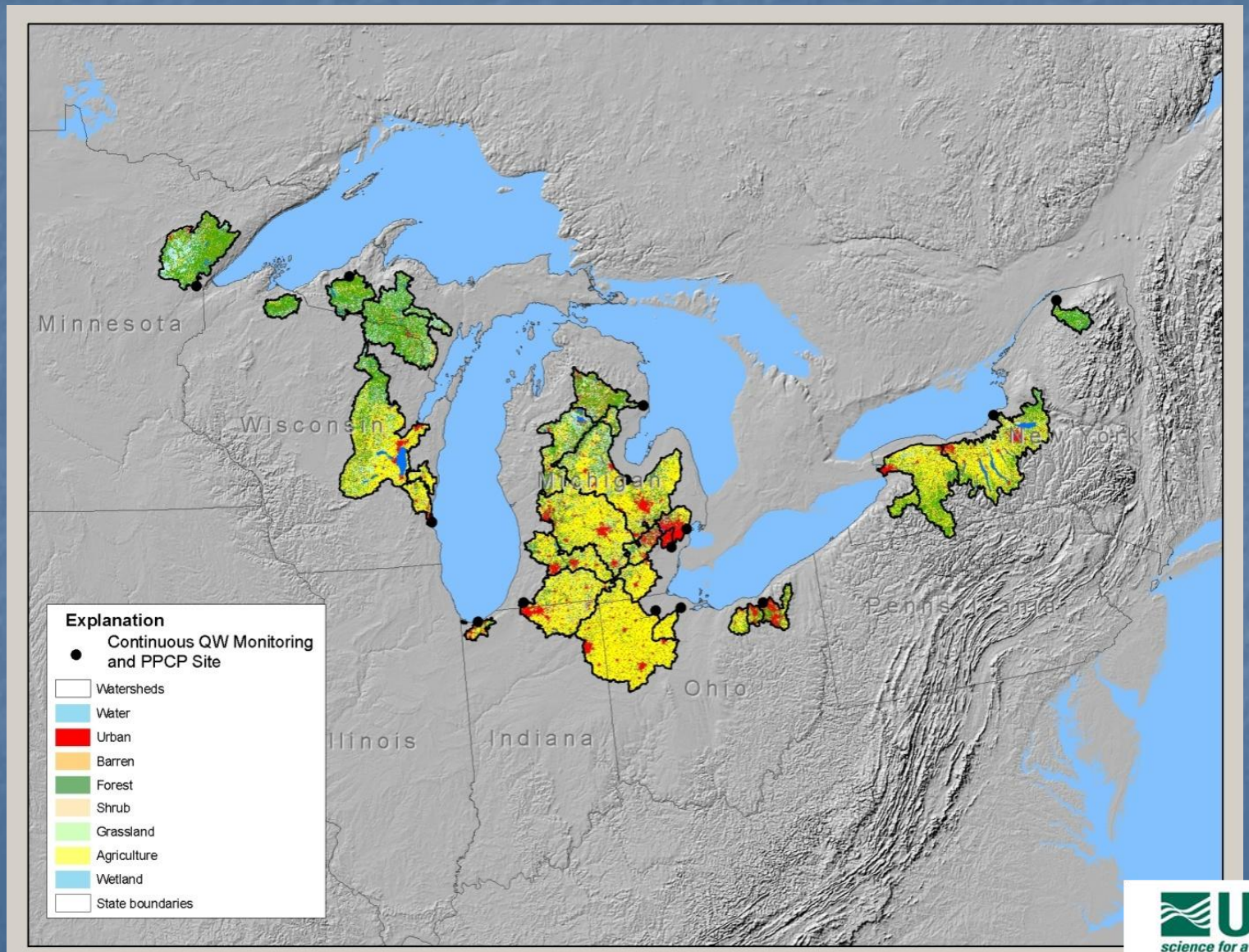
30 NMN River sites instrumented for automated and continuous monitoring



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Automated Sampling

- Analytes include:
  - suspended sediment, nutrients, chloride, and bacteria.
  - one sample per storm event will be analyzed for major ions.
  - Continuously sensed data: High Turbidity, Low Turbidity, Temperature, Conductivity, Dissolved Oxygen, pH
- Monthly base flow samples (12) plus eight storms will be sampled with 6 samples submitted per storm (60 environmental samples per site)
- Samples will be used to develop statistical relations between continuously measured parameters and lab analyzed parameters.

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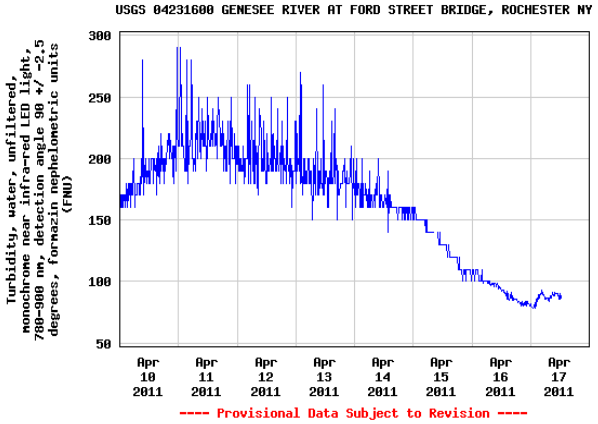
Real-time sensor monitoring information available at: http://waterwatch.usgs.gov/wqwatch/

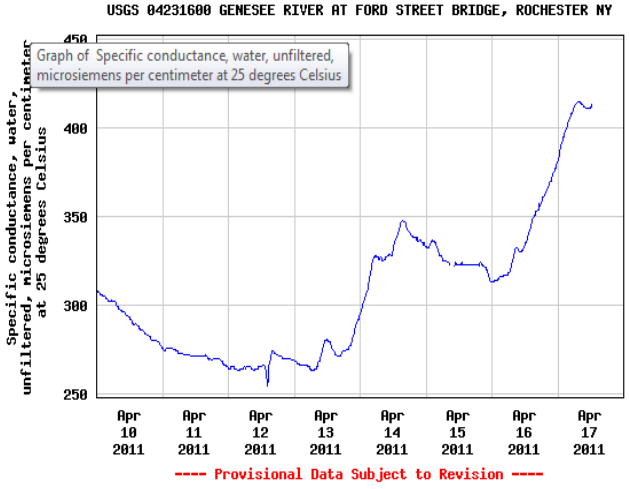
Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +/ -2.5 degrees, formazin nephelometric units (FNU)

Most recent instantaneous value: 87 04-17-2011 12:30 EST



Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius

Most recent instantaneous value: 413 04-17-2011 12:30 EST



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Real-time Water Quality Monitors

Directly measured		Computed or estimated
Gage Height/Stage	→	Streamflow (discharge)
Specific Conductance	→	Chloride, alkalinity, fluoride, dissolved solids, sodium, sulfate, nitrate, atrazine
Turbidity	→	Total suspended solids, suspended sediment, fecal coliform, E. coli, total nitrogen, total phosphorus

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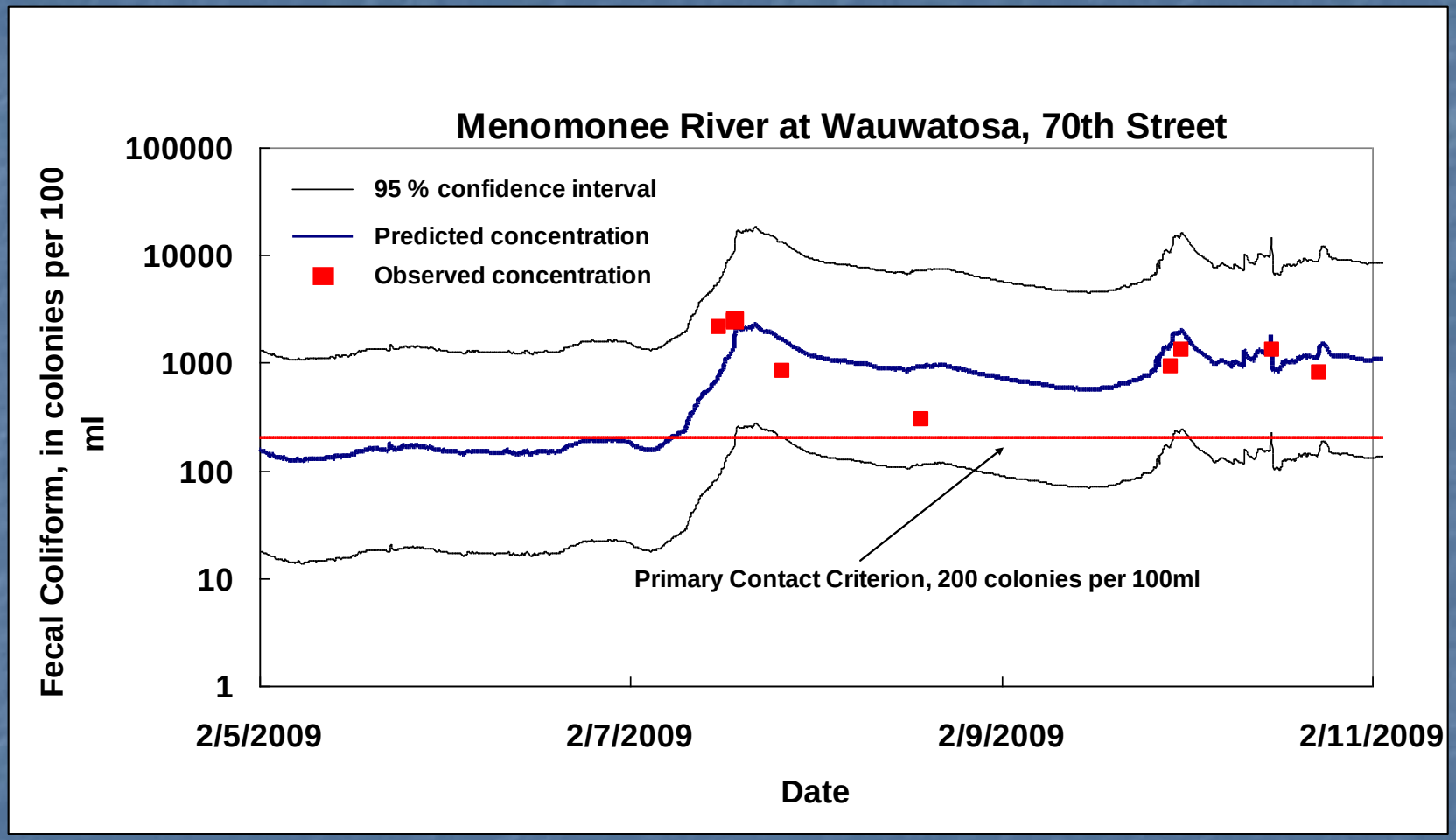
Example of Real Time Surrogate



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17 NMN River sites monitored for chemicals of emerging concern (PPCP - pharmaceuticals and personal care products)

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Chemicals of Emerging Concern

- At 17 sites representing agricultural, urban and reference conditions. Ten of the which are located at AOCs.
  - Collect monthly and 6 storms samples (18 samples annually) for Pharmaceuticals and Personal Care Products

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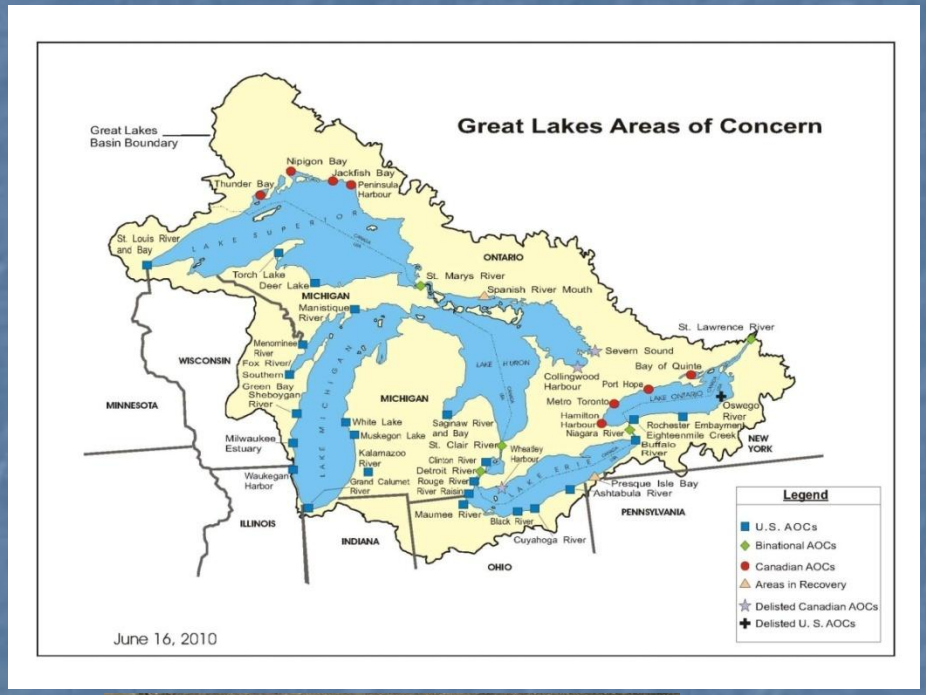
Determine Baseline of Toxic Contaminants in Sediments

- At 15 AOC sites in the Great Lakes Sediment traps were installed

  Analyzed for over 150 constituents:
  - PAH's and Total PCB's
  - Alkylated PAH's,
  - Pharmaceuticals



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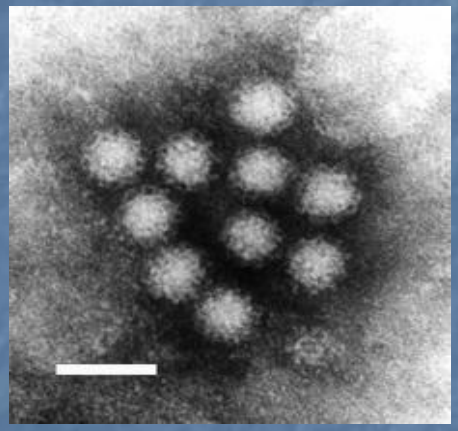
Monitoring Tributaries for Pathogens and Viruses

- At 8 of the chemicals of emerging concern sites (6 AOCs) collect samples every other month (base flow) and for 12 storms using an auto sampler:
  - Monitor for 8 human viruses, 10 bovine viruses, 3 bacterial pathogens, and cryptosporidium



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Testing Automated Underwater Vehicles and CDOM Sensors

- Test Ecomapper AUV) in Milwaukee Harbor (2010), Green Bay, Sheboygan and Muskegon (2011)
- Chromophoric Dissolved Organic Matter (CDOM) sensors tested at tributary gages and deployed from a boat in embayments as a surrogate for toxic contaminants
- Tie the river sensors and CDOM measurements to AUV work in the embayments, and Triaxus tow and buoy activities in the near shore, and to beach health monitoring.

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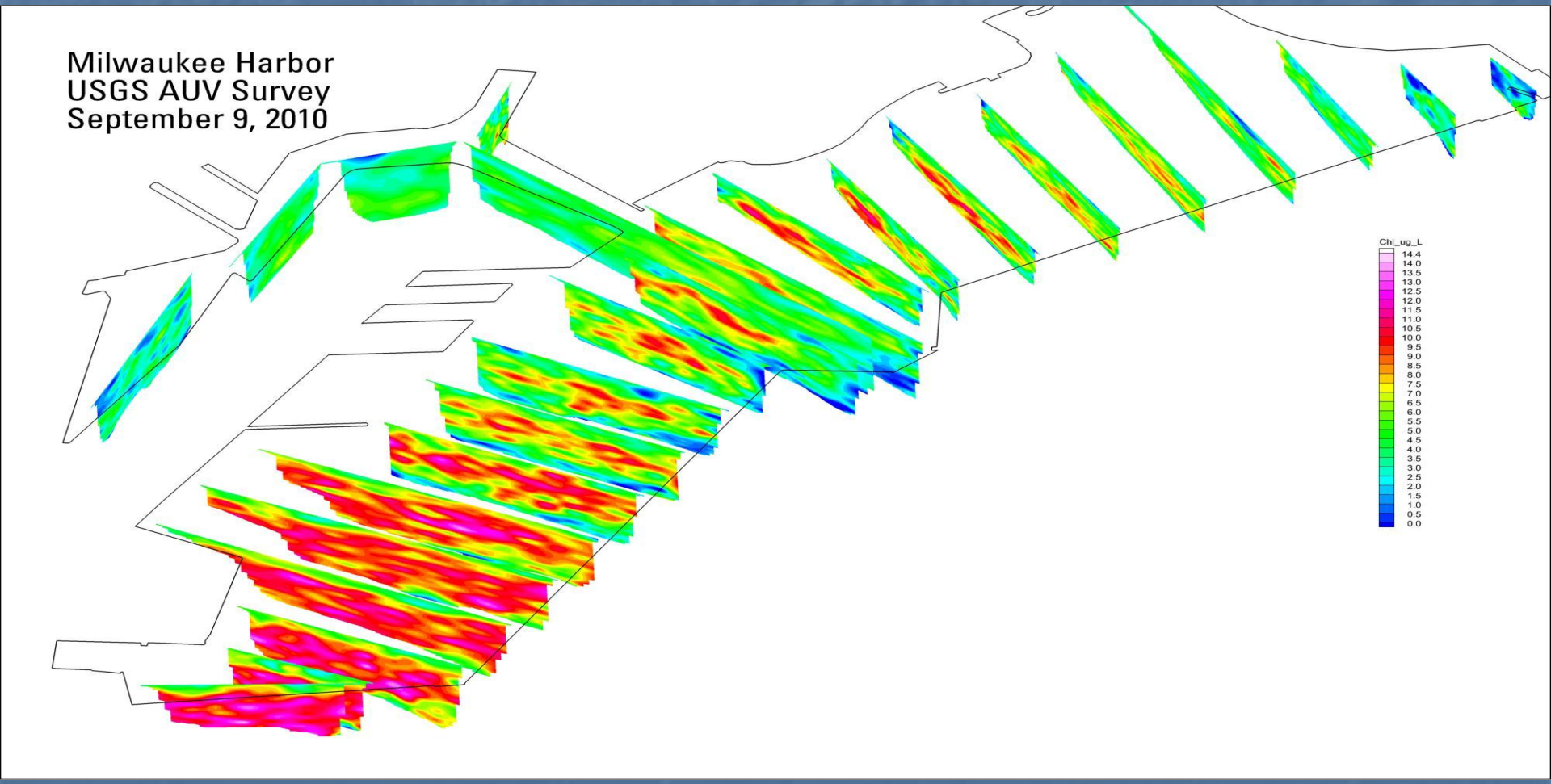
AUV Example Output - Chlorophyl



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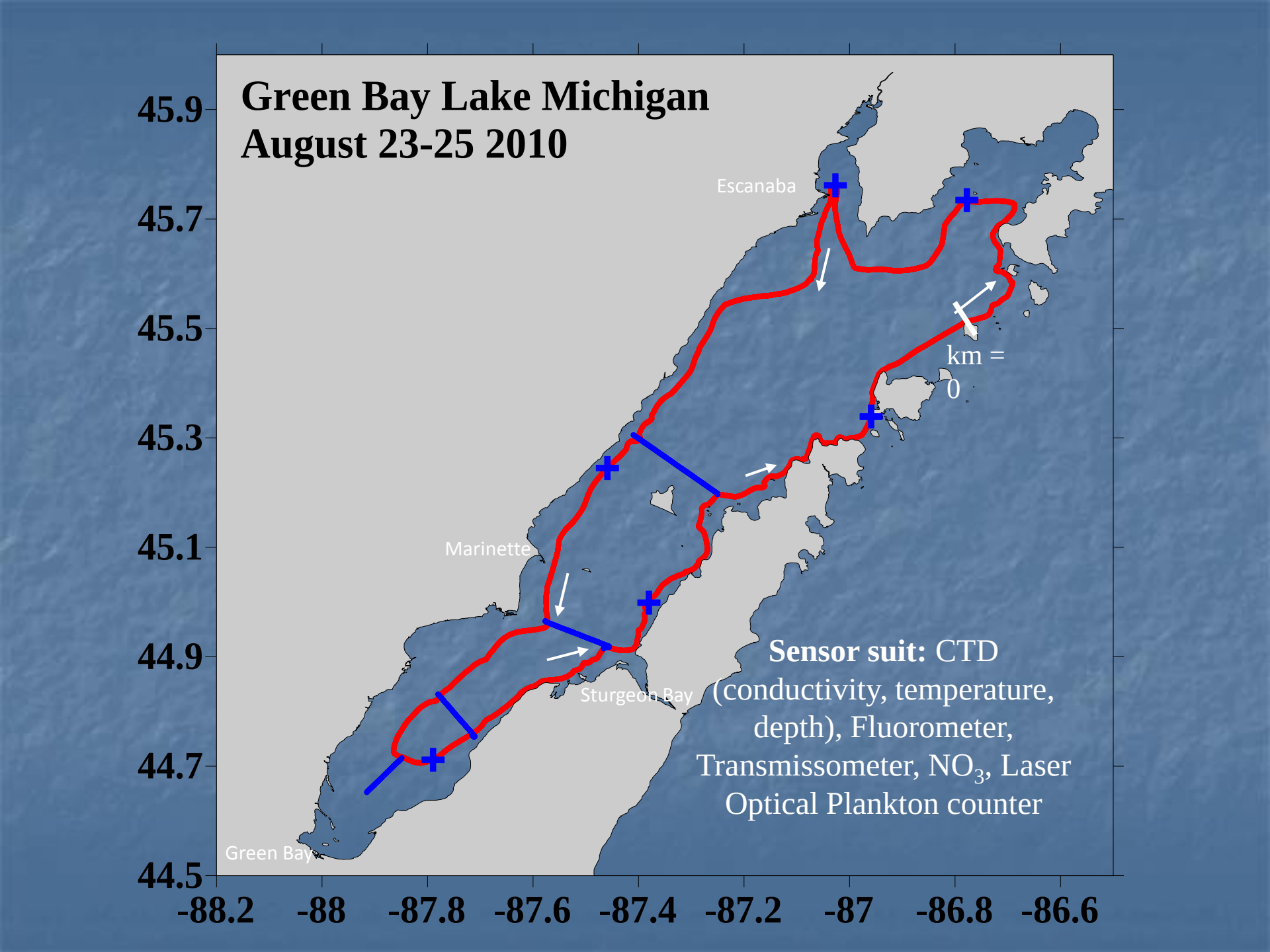
Green Bay Lake Michigan
August 23-25 2010
Escanaba
Marinette
Sturgeon Bay
Green Bay
km = 0
Sensor suit: CTD (conductivity, temperature, depth), Fluorometer, Transmissometer, NO_3, Laser Optical Plankton counter
45.9
45.7
45.5
45.3
45.1
44.9
44.7
44.5
-88.2
-88
-87.8
-87.6
-87.4
-87.2
-87
-86.8
-86.6

Thank you

Questions?

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Watershed modeling

- Identify current watershed modeling activities in the Great Lakes (in press)
- Develop HSPF models for 3 sub basins (Kalamazoo, Towanda, Bad), which are representative of the hydrogeology, physiography, land types, of a large region of the Great Lakes basin, and simulate water-quality processes
- Scenario development and comparison of results
  - Land–use changes
  - Management practices
  - Detention basins
  - Climate change

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Land Cover Map of Three Watershed Modeling Basins

Hydro SPARROW

- Develop Hydro SPARROW – a GIS link between SPARROW (a water-quality model) and WATER/PRMS (water-quantity models)
- Use Hydro SPARROW to provide an estimate of phosphorus and nitrogen loading to the Great Lakes under a variety of land use and climate change scenarios

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